At page 1, please AMEND the PARAGRAPH beginning on line 18 with the words "Most microchannel systems ...", as shown below.

At page 3, please AMEND the PARAGRAPH beginning on line 25 with the words "FIGURE 1 schematically illustrates ...", as shown below.

At page 5, please AMEND the PARAGRAPH beginning on line 14 with the words "To produce a sample band ...", as shown below.

At page 6, please AMEND the PARAGRAPH beginning on line 17 with the words "FIGURE 2 schematically illustrates...", as shown below.

At page 8, please AMEND the PARAGRAPH beginning on line 1 with the words "To produce the thickness...", as shown below.

At page 8 please AMEND the PARAGRAPH beginning on line 21 with the words "In the second step...", as shown below.

At page 15 please AMEND the PARAGRAPH beginning on line 22 with the words "FIGURES 2A – 2H ...", as shown below.

At page 15 please AMEND the PARAGRAPH beginning on line 25 with the words "FIGURES 3A – 3H ...", as shown below.

At page 15 please AMEND the PARAGRAPH beginning on line 28 with the words "FIGURES 4A – 4H ...", as shown below.

At page 16 please AMEND the PARAGRAPH beginning on line 1 with the words "FIGURES 5A – 5L ...", as shown below.

At page 16 please AMEND the PARAGRAPH beginning on line 3 with the words "FIGURES 6A – 6P ...", as shown below.

At page 16 please AMEND the PARAGRAPH beginning on line 5 with the words "FIGURES 7A – 7P ...", as shown below.

At page 16 please AMEND the PARAGRAPH beginning on line 7 with the words "FIGURES 8A – 8L ...", as shown below.

At page 16 please AMEND the PARAGRAPH beginning on line 9 with the words "FIGURES 9A – 9L ...", as shown below.

At page 17, please AMEND the PARAGRAPH beginning on line 7 with the words "The present invention improves...", as shown below.

At page 18 please AMEND the PARAGRAPH beginning on line 17 with the words "After fabricating...", as shown below.

At page 18 please AMEND the PARAGRAPH beginning on line 24 with the words "Chemical or biological samples...", as shown below.

At page 20, please AMEND the PARAGRAPH beginning on line 9 with the words "The calculations presented...", as shown below.

At page 21, please AMEND the PARAGRAPH beginning on line 12 with the words "In all of the example...", as shown below.

At page 22, please AMEND the PARAGRAPH beginning on line 4 with the words "These new methods...", as shown below.

At page 24, please AMEND the PARAGRAPH beginning on line 22 with the words "It is also important...", as shown below.

At page 25, please AMEND the PARAGRAPH beginning on line 1 with the words "In the third and final...", as shown below.

At page 26, please AMEND the PARAGRAPH beginning on line 18 with the words "The new four-step process...", as shown below.

At page 29, please AMEND the PARAGRAPH beginning on line 29 with the words "A fourth embodiment...", as shown below.

At page 30, please AMEND the PARAGRAPH beginning on line 29 with the words "A fifth embodiment...", as shown below.

At page 31, please AMEND the PARAGRAPH beginning on line 5 with the words "The first step...", as shown below.

At page 32, please AMEND the PARAGRAPH beginning on line 27 with the words "Sample manipulation...", as shown below.

At page 35 please AMEND the PARAGRAPH beginning on line 5 with the words "Similarly, all of the examples...", as shown below.

At page 35, please AMEND the PARAGRAPH beginning on line 18 with the words "The present invention…", as shown below.

AMENDMENTS TO THE SPECIFICATION

ON PAGE 1

AT ORIGINAL LINE 18 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "Most microchannel systems for ..." AND ENDING WITH THE WORDS "...consequent differing ion speeds." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

Most microchannel systems for chemical and biological analysis employ some variant of electrochromatographic or electrophoretic separation. In chromatographic processes, bulk electroosmotic motion of a fluid is induced by applying an electric field along the length of the separation column. Individual species move through the column at various speeds due to preferential adsorption on stationary surfaces such as the channel walls or an internal porous packing. In contrast, electrophoretic processes involve little or no bulk fluid motion. Here the applied electric field instead produces motion of ionic species through a stationary or nearly stationary transport medium that may be either a fluid or a gel. Species separation in electrophoretic processes occurs as a result of differing ratios of the ion charge to the ion mobility and consequent differing ion speeds. **[[.]]**

ON PAGE 3 AND CONTINUING TO PAGE 4

AT ORIGINAL LINE 25 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "FIGURE 1 schematically illustrates ..." AND ENDING WITH THE WORDS "...through leads **106' – 109'** respectively." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

FIGURE 1 schematically illustrates a very simple microchannel system **100** for chemical analysis. Here, the channels are fabricated on a planar substrate **101**. Reservoirs **102 – 105** have access ports (not shown) that permit introducing and extracting fluid through the top or bottom faces of the substrate. Channels **112 – 115** are filled with a fluid or gel-material hereinafter referred to as a "transport medium," which supports migration of ions or charged particles of a sample material either through or with the transport medium under the influence of an applied electrical field.

The process channels **112** – **115** may also contain a separation matrix comprising a porous or granular material, a microfabricated pattern of obstacles, or a plurality of protrusions that promote species separation. The reservoir access ports (not shown) may also be used to control the hydrostatic pressures in the reservoirs or they may be left open to maintain reservoir pressures equal to the atmospheric pressure. Similar access holes (not shown) are used to insert electrodes **106** – **109** that are connected to power supply **110** through leads **106'** – **109'** respectively.

ON PAGE 5 AND CONTINUING TO PAGE 6

AT ORIGINAL LINE 14 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "To produce a sample band ..." AND ENDING WITH THE WORDS "...exceeds the channel width." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

To produce a sample band and inject it into process channel **112** of system **100**, the sample material is first introduced into the lower supply channel reservoir **103** and then transported through supply channel **113** by applying an electric field along supply channel **113** and waste channel **114**. This field is applied by using the power supply to impose a potential difference between the electrode **107** in the supply reservoir **103** and the electrode **106** in the waste reservoir **102** terminating waste channel **114**. During this step of the process, the power supply prevents any current flow to electrodes **109** and **108** located in the buffer and process reservoirs **104** and **105**, respectively, so as to prevent any significant transport along the buffer and process channels, **115** and **112**. After completing this step, the junction **111** is filled with sample material (not shown). This volume of sample material contained within the junction is then transported into the process channel **112** to form the sample band. The sample transport during this step is induced by applying an electric field along buffer and process channels[[,]] **115** and process channel **112** using the buffer and process channel electrodes **109** and **108** respectively. During this step the power supply prevents current flow along the supply and waste channels. However, because the electric field lines tend to bulge from the primary channel into the ends of the supply and waste channels, sample material is removed from the supply and waste channels, forming a tail on the sample band as it is

transported along the process channel. As a result, a sample band produced in this manner generally has a thickness that exceeds the channel width.

ON PAGE 6 AND CONTINUING TO PAGE 7

AT ORIGINAL LINE 17 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "FIGURE 2 schematically illustrates ..." AND ENDING WITH THE WORDS "..., again for clarity." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

FIGURE 2 schematically illustrates the sample transport for the conventional two-step process (described above) used to produce a sample band **200** and inject it into a process channel **202**. The first step of this process is shown in the upper sequence of frames comprising FIGURES 2A – 2D. These frames illustrate the behavior of flow through channels **201** – **204** at four succeeding instants in time. Time increases from left to right, with each frame later than the preceding frame by a discrete increment of time, t_i The lower sequence of four frames (FIGURE 2E – 2H) illustrates the second step of the process, again read from left to right. The first frame, FIGURE 2E, of the second step (second row) is identical to the last frame, FIGURE 2D, of the first step (first row). For the sake of clarity and to promote a better ~~of the~~ understanding of the invention, only the channel segments near the junction **205** are shown. Furthermore, those regions *within* the channel which are occupied by sample material are illustrated as comprising a plurality of black dots, analogous to tracer particles that are carried along with the sample, again for clarity.

ON PAGE 8

AT ORIGINAL LINE 1 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "To reduce the thickness ..." AND ENDING WITH THE WORDS "...waste reservoirs (not shown)." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

To reduce the thickness of injected samples and to help eliminate sample tails, improved methods of sample manipulation have been explored in the prior art. FIGURES 3A – 3H ~~illustrates~~ <u>illustrate</u> an improved prior-art two-step method used in

the prior art to produce and inject a sample band. This improved method reduces the thickness, ***d***, of the sample band **200** and largely eliminates the long trailing tails **200'** shown earlier in FIGURES 2A – 2H. The first step in this method is the same as shown previously; the top set of frames, FIGURES 3A – 3D, are identical to those in FIGURES 2A – 2D. The sample material **206** is first transported along the supply channel **204**, through the junction **205** and then toward the waste channel reservoir (not shown). The lower frames, FIGURES 3E – 3H, show subsequent transport of the sample band **200** into the process channel **202**. In contrast to FIGURES 2A – 2H, the electric potentials of FIGURES 3A – 3H are applied to the four reservoir electrodes (not shown) in a manner that causes transport (shown as arrows **208** in FIGURE 3F) from the buffer channel **203** into the supply **204**, waste **201**, and process **202** channels, injecting sample band **200_3** into the process channel **202**. In the last two frames, FIGURES 3G – 3H, the sample band is moving from left to right along the process channel toward a detector (not shown), while other portions of sample material are moving from the junction **205** toward both the supply and waste reservoirs (not shown).

ON PAGE 8 AND CONTINUING TO PAGE 9

AT ORIGINAL LINE 21 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "In the second step ... " AND ENDING WITH THE WORDS "...a process channel **202**." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

In the second step of the process, FIGURES 3E – 3H, the field is applied by setting the electrode potential of the buffer reservoir above the potential of each of the other three reservoirs. In general, however, the required polarity of the applied field depends upon the sign of the Zeta potential in electroosmotic flows while in electrophoresis the required polarity depends on the sign of the charge on the ion species comprising the sample. In the particular example shown in FIGURES 3E – 3H, the magnitude of the applied electric field in the waste, process and supply channels, **201**, **202**, **204** respectively, is the same. However, this need not be the case, in general, provided that the mean transport speeds in supply and waste channels **204** and **201** are a significant fraction of the mean transport speed in process channel **202**.

ON PAGE 15

AT ORIGINAL LINE 22 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "FIGURES 2A – 2H ... " AND ENDING WITH THE WORDS "...shown in FIGURE 12." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

FIGURES 2A – 2H ~~illustrates~~ illustrate a conventional method for producing and injecting a sample band. The illustration is based on the simulation results shown in FIGURE 12.

ON PAGE 15

AT ORIGINAL LINE 25 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "FIGURES 3A – 3H ... " AND ENDING WITH THE WORDS "...shown in FIGURE 13." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

FIGURES 3A – 3H ~~illustrates~~ illustrate a conventional method for producing and injecting a sample band. The illustration is based on the simulation results shown in FIGURE 13.

ON PAGE 15

AT ORIGINAL LINE 28 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "FIGURES 4A – 4H ... " AND ENDING WITH THE WORDS "...shown in FIGURE 14." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

FIGURES 2A – 2H ~~illustrates~~ illustrate a conventional method for producing and injecting a sample band. The illustration is based on the simulation results shown in FIGURE 12.

ON PAGE 16

AT ORIGINAL LINE 1 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "FIGURES 5A – 5L ... " AND ENDING WITH THE WORDS "...shown in FIGURE 15." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

FIGURES 5A – 5L ~~illustrates~~ illustrate a conventional method for producing and injecting a sample band. The illustration is based on the simulation results shown in FIGURE 15.

ON PAGE 16

AT ORIGINAL LINE 3 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "FIGURES 6A – 6P ... " AND ENDING WITH THE WORDS "...shown in FIGURE 16." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

FIGURES 6A – 6P ~~illustrates~~ illustrate a conventional method for producing and injecting a sample band. The illustration is based on the simulation results shown in FIGURE 16.

ON PAGE 16

AT ORIGINAL LINE 5 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "FIGURES 7A – 7P ... " AND ENDING WITH THE WORDS "...shown in FIGURE 17." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

FIGURES 7A – 7P ~~illustrates~~ illustrate a conventional method for producing and injecting a sample band. The illustration is based on the simulation results shown in FIGURE 17.

ON PAGE 16

AT ORIGINAL LINE 7 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "FIGURES 8A – 8L ... " AND ENDING WITH THE WORDS "...shown in FIGURE 18." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

FIGURES 8A – 8L ~~illustrates~~ illustrate a conventional method for producing and injecting a sample band. The illustration is based on the simulation results shown in FIGURE 18.

ON PAGE 16

AT ORIGINAL LINE 9 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "FIGURES 9A – 9L ... " AND ENDING WITH THE WORDS "...shown in FIGURE 19." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

FIGURES 9A – 9L ~~illustrates~~ illustrate a conventional method for producing and injecting a sample band. The illustration is based on the simulation results shown in FIGURE 19.

ON PAGE 17

AT ORIGINAL LINE 7 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "The present invention improves ... " AND ENDING WITH THE WORDS "...trapezoidal and triangular." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

The present invention improves the performance of microchannel systems for chemical and biological synthesis and analysis by providing a method and apparatus for producing a thin band of a species sample. Thin sample bands improve the resolution of microchannel separation processes, as well as many other processes requiring precise control of sample size and volume. These improvements are applicable to microfluidic systems employing electroosmotic transport, electrophoretic transport, or pressure-driven flows. The present invention is applicable to all channel depths and to a range of channel cross-sections including, for example, rectangular, trapezoidal and triangular.

ON PAGE 18

AT ORIGINAL LINE 17 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "After fabricating the microchannel system ... " AND ENDING WITH THE WORDS "...or by scanning images." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

After fabricating the microchannel system the planar substrate **[[it]]** is usually, but not necessarily, mated with one or more planar sheets that seal channel tops and/or bottoms while providing access holes for injection and extraction ports as well as electrical connections. In all such fabrication processes the channel geometries are initially imprinted by lithographic masks capable of accurately reproducing detailed channel dimensions defined by digital data sets or by scanning images.

ON PAGE 18 AND CONTINUING TO PAGE 19

AT ORIGINAL LINE 24 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "Chemical or biological samples ... " AND ENDING WITH THE WORDS "...as a transport medium." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

Chemical or biological samples are transported through microfluidic devices by electroosmosis, electrophoresis, or by pressure driven flow. In electroosmosis, bulk flow is induced by applying an electric field to a fluid containing a net mobile charge within the Debye layers adjacent to channel surfaces. In electrophoresis, by contrast, there is generally limited bulk motion of the fluid or gel contained within the separation channels. Instead, the applied electric field causes migration of ionic species through a substantially stationary medium, at speeds that depend on the ion charges and mobilities of the species. Both of these processes may occur simultaneously when an electric field is applied to a fluid, though one is usually dominant. In pressure driven flow, bulk fluid motion is induced by applying a pressure difference between channel ends. The present invention is applicable to all electroosmotic and electrophoretic transport processes and to pressure driven flows in devices having channel depths small compared to their widths. Any of these three processes involve species transport along**[[,]]** with, or through a fluid, a gel, or a similar material, hereinafter referred to as a transport medium.

ON PAGE 20

AT ORIGINAL LINE 9 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "The calculations presented ... " AND ENDING WITH THE WORDS "...described by a random walk." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

The calculations presented here are performed for the limiting case in which the Debye layer thickness is negligible compared to the channel width. This approximation is generally well justified since Debye layers are typically at least 100 times thinner than minimum channel dimensions. Under these conditions the electric field satisfies the

Laplace equation, and the induced fluid speed along channel boundaries that are electrically insulating is proportional to the local field strength, in accordance with the Smoluchowski relationship. The velocity field within the channels and junction is computed by solving the full Navier-Stokes equations by means of a stream function and vorticity formulation. Finally, species transport is computed by a Monte Carlo method in which a large number of tracer particles are introduced into the flow and subsequently move by advection and diffusion. The advective transport is computed in a deterministic fashion from the local fluid speed, while diffusive transport is described by a random walk.

ON PAGE 21

AT ORIGINAL LINE 11 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "In all of the example calculations ... " AND ENDING WITH THE WORDS "...to the applied field." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

In all of the example calculations presented here the sample material consists of neutral species that ~~is~~ are transported by electroosmotic flows induced by applied electric fields. However, the computed sample band transport is equally descriptive of electrophoretic transport of charged sample species through a stationary transport medium. It is also descriptive of sample transport by any combination of these two electrokinetic mechanisms. This equivalence holds true provided that the Debye layer is thin compared to the transverse channel dimensions and there are no applied pressure gradients, as is typical of practical microchannel devices. Under these restrictions[[,]] and a few lesser assumptions, both of the basic electrokinetic transport processes induce sample transport along current flux lines and the transport speed is proportional to the magnitude of the local electric field. In electroosmosis this transport speed is the bulk fluid speed while in electrophoresis it is the ion drift speed relative to the transport medium. When both mechanisms occur simultaneously, the speed of a particular ion species is the sum of the electroosmotic and electrophoretic components, which is still simply proportional to the applied field.

ON PAGE 22

AT ORIGINAL LINE 4 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "These new methods ... " AND ENDING WITH THE WORDS "...resulting sample band." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

These new methods comprise a series of steps in which the sample is manipulated within the junction and the channels that intersect the junction. The required sample manipulations can be performed using conventional channel and junction geometries. In this case, the method is readily implemented by programming a power supply to perform the required steps of applying electric potentials to reservoir electrodes or, equivalently, of imposing electric currents along some or all of the channels intersecting the junction. Alternatively, the same sample manipulations may be performed in improved junction geometries, providing still further reductions in the thickness of the resulting sample band.

ON PAGE 24

AT ORIGINAL LINE 22 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "It is also important ... " AND ENDING WITH THE WORDS "...sample band **200**$_5$." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

It is also important to note that by increasing sample speeds during this second step or by increasing the duration of the transport through supply and waste channels **204** and **201**, the volume of the precursor sample band **207'** is reduced which has the effect of also reducing the thickness, ***d***, of the injected sample band **200**$_5$. Likewise, the opposite is true: reducing the speeds or duration of the transport through supply and waste channels **204** and **201** increases the retained sample volume **207'** and so will increase the thickness of injected sample band **200**$_5$.

ON PAGE 25

AT ORIGINAL LINE 1 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "(3.) In the third and final step ... " AND ENDING WITH THE WORDS "...of the channel width." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

(3.) In the third and final step, illustrated in FIGURES 5I – 5L, the initial sample band **207'** that has been produced within the buffer channel **203** is thinned by transporting it across junction **205** toward the process channel **202** while also extracting portions of the sample band **207'** into the supply and waste channels, **204** and **201**. As with the relationship between the first and second steps of FIGURES 2 and 3, the last frame of the second step FIGURE 5H is identical to the first frame of the third step FIGURE 5I. During this step, the applied electric fields are similar to those used in FIGURES 3E – 3H (Step 2): the electric potential in the buffer channel reservoir (not shown) is raised above that in the reservoirs terminating the supply, waste and process channels (not shown). This step is not, however, equivalent to that previous procedure because it is not used here to create an initial sample band as in the prior art. Instead, the present method uses the diverging transport field within the junction **205** to reduce the thickness of a sample band **207'** that has already been formed in steps (1) and (2) above and positioned to take maximum advantage of the diverging transport field induced during this final step. Since the starting position of the sample band **207'** is now to the left of the junction **205**, rather than actually within junction **205**, a portion of the sample is carried away from the junction into the supply and waste channels **204** and **201**. This occurs because as sample band **207'** leaves buffer channel **203** and traverses junction **205**, the radial divergence of the transport field leaving the buffer channel stretches the sample band, further thinning the sample before it enters the process channel. This method of using a divergent transport field to stretch and thin a sample band is a unique aspect of the present invention. The end result of this three-step process is a sample band **200_5** having a thickness equal to about one-third of the channel width.

ON PAGE 26

AT ORIGINAL LINE 18 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "The new four-step process ... " AND ENDING WITH THE WORDS "...FIGURES 2C, 3C, 5C and 6C." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

The new four-step process**[[,]]** illustrated in FIGURES 6A – 6P**[[,]]** proceeds as follows:

(1.) As before, sample material **206** is transported through supply channel **204** until it fills junction **205** and continues to move toward the waste reservoir (not shown) through waste channel **201**. This step produces an initial sample volume near junction **205** that again intrudes about one channel width into the buffer and process channels **203** and **202**, respectively, to the left and right of junction **205**, forming the distinctive lobes **207** of FIGURES 2C, 3C, 5C and 6C.

ON PAGE 29 AND CONTINUING TO PAGE 30

AT ORIGINAL LINE 28 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "A fourth embodiment ... " AND ENDING WITH THE WORDS "...other three reservoirs." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

A fourth embodiment of this invention, illustrated schematically by FIGURES 8A – 8H, differs significantly from those already discussed. Again, the illustrations of FIGURE 8 are based on a computer simulation graphically shown in FIGURE 18. Rather than thinning the sample band by stretching the sample band within the junction, this last method employs sample focusing similar to that illustrated in FIGURES 4A - 4H. However, in the present invention, focusing is performed within a *single* junction **205** using a three-step process that does not require the use of the additional junction seen in FIGURES 4A – 4D, and the additional hardware previously described as part of the FIGURE 4 prior art device. To focus a sample **200** within the junction **205** by means of the present invention, the junction is first filled from the supply channel **204** in the presence of *simultaneous* current flow into junction **205** from both the buffer and process channels **203** and **202**, FIGURES 8B and 8C. This leaves a focused portion

206' of sample stream **206** in the waste channel **201**, and with the supply channel **202** completely filled. Such asymmetry between the top and bottom would lead to injection of a long and a lopsided band into the process channel. To avoid this, a second step, FIGURES 8E – 8H, is taken in which an electric ~~filed~~ field is applied along the waste and supply reservoirs (not shown) to induce sample transport in the direction OPPOSITE to Step 1. This moves the focused sample **206'** downward into and through the junction, and results in a sample distribution like that shown in step 2, FIGURE 4E. During this second step the current flow and transport in the buffer and process channels **203** and **202** may be held static or, alternatively, directed into junction **205** to further thin the sample. As with the methods employing multiple thinning steps, Steps 1 and 2 of this method may be repeated multiple times to further thin a sample volume **206'** prior to injection. The final step in this method, FIGURES 8I – 8L, transports **[[of]]** a portion of the focused sample stream **206'** across the junction **205** into the process channel, thereby producing the final sample band $\mathbf{200'_8}$. This may be performed by raising the potential in the buffer channel reservoir above those in the other three reservoirs.

ON PAGE 30 AND CONTINUING TO PAGE 31

AT ORIGINAL LINE 29 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "A fifth embodiment ... " AND ENDING WITH THE WORDS "...unique to the present invention." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

A fifth embodiment of the present invention is illustrated schematically in FIGURES 9A – 9L, which is based on the computer simulation shown in FIGURE 19. As in the preceding fourth embodiment, sample thinning and injection is performed using a single junction. However, rather than using a focusing step as a part of the thinning process, the fifth embodiment uses an axial stretching process unique to the present invention.

ON PAGE 31

AT ORIGINAL LINE 5 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "The first step ... " AND ENDING WITH THE WORDS "...into the process channel." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

The first step in this new stretching and injection process is simply the familiar filling of the junction by transport of sample material from the supply channel **204** into the waste channel **201**, as seen in FIGURES 9A – 9D. In the second step, shown in FIGURES 9E – 9H, current flow is directed from the buffer and process channels, **202** and **203**, into the junction and out through the supply and waste channels. As a result, the band of sample material **220** remaining within the junction is axially stretched and thinned. In the example shown, the nearly identical current flows from the buffer and process channels produce a thinned sample that is centered within the junction. A moderate imbalance of these currents would simply shift the stretching band off of the center of the junction. The sample band **220** continues to stretch as long as the electric fields are applied[[. So]] so the sample can be easily thinned to any desired final thickness. The third and final step of the fifth embodiment, FIGURES 9I –9L, provides injection of the stretched sample into process channel **203**. This is done here by raising the potential in the buffer channel above that in the other three channels, thereby injecting the final sample band **$200'_9$** into the process channel.

ON PAGE 32 AND CONTINUING TO PAGE 33

AT ORIGINAL LINE 27 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "Sample manipulation in a conventional junction ... " AND ENDING WITH THE WORDS "...in FIGURE 10." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

Sample manipulation in a conventional junction, as illustrated here, is very effective in reducing and controlling the thickness of the resulting sample band. However, as the sample volume is increasingly thinned, the resulting band thickness becomes dominated by the bow of the band just before it enters the process channel. The origin of this bow is the fact that sample speeds near the walls of the process

channel and adjacent to the junction are reduced from the centerline values due to nearby transport into the supply and waste channels. One means to eliminate these local regions of low transport speed is to reduce the overall transport into the supply and waste channels. However, such transport is desirable for minimizing tails on the resulting sample band and provides the radial divergence of the transport field necessary for the effective sample thinning. A better approach is to alter the geometry of the junction in the vicinity of the process channel to reduce the influence of the supply and waste channels on speeds near the process channel. Such a geometry is ~~show~~ shown in FIGURE 10.

ON PAGE 35

AT ORIGINAL LINE 5 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "Similarly, all of the examples ... " AND ENDING WITH THE WORDS "...than two dimensions." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

Similarly, all of the examples shown here address the case in which the channels of a microchannel system all lie in a common plane, since this is the most straight-forward configuration to describe and fabricate and thereby to actually reduce to practice. However, the methodology and apparatus disclosed and illustrated in these two-dimensional planar networks can be easily extended to three-dimensional networks in which a junction can be formed by the intersection of six channels with four of these lying in a common plane and the other two lying in an orthogonal plane. Such devices offer the opportunity for sample thinning by divergent flow in three rather than two dimensions.

ON PAGE 35 AND CONTINUING TO PAGE 36

AT ORIGINAL LINE 18 OF THE SPECIFICATION, IN THE PARAGRAPH BEGINNING WITH THE WORDS "The present invention ... " AND ENDING WITH THE WORDS "...pressure gradients." PLEASE AMEND THE SPECIFICATION WITH THE REPLACEMENT PARAGRAPH AS FOLLOWS:

The present invention and the illustrative calculations presented here are applicable not only to transport by electroosmotic flow and by electrophoresis but also

to some pressure driven flows. To establish this range of application, it is first noted that the vorticity in an electroosmotic flow is everywhere zero under fairly general conditions, regardless of the channel geometry. The main requirements are that there are no applied pressure gradients, that the Debye layers be thin compared to transverse channel dimensions, and that the fluid properties and properties of the channel boundaries are everywhere the same. The geometry of the channel or channels need not be restricted in any way. Under these conditions, the fluid motion is a potential flow and the fluid velocity is uniformly proportional to the applied electric field. In this regard an electroosmotic potential flow is completely analogous to electrophoretic species motion. It is therefore understood that methods and channel geometries that are beneficial for producing thin sample bands via electroosmotic flow are also beneficial via electrophoretic motion. Moreover, these methods and apparatus are also applicable to channels filled with a porous or granular solids since the presence of these elements does not alter channel-scale transport in potential flows. Pressure-driven flows in wide shallow channels and in channels filled with a separation matrix such as a porous or granular ~~materials~~ material may also be potential flows. For these special cases, the present methods and apparatus are also applicable to flows driven by applied pressure gradients.